3.2 Highly Migratory Species (HMS) Habitat

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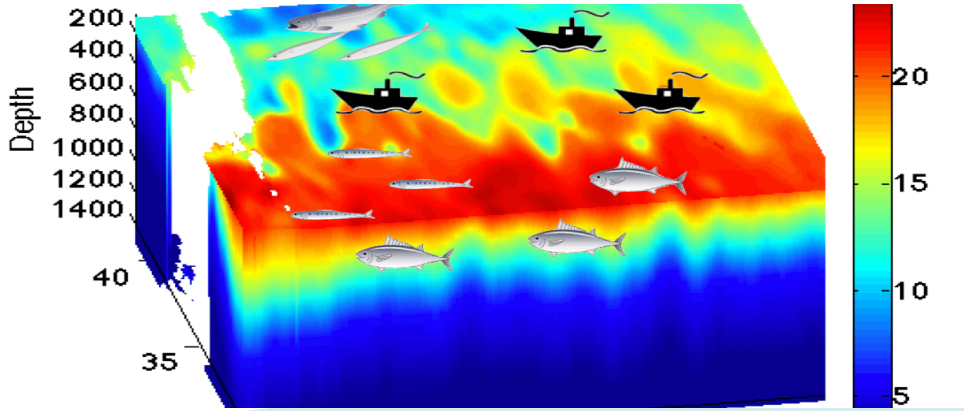
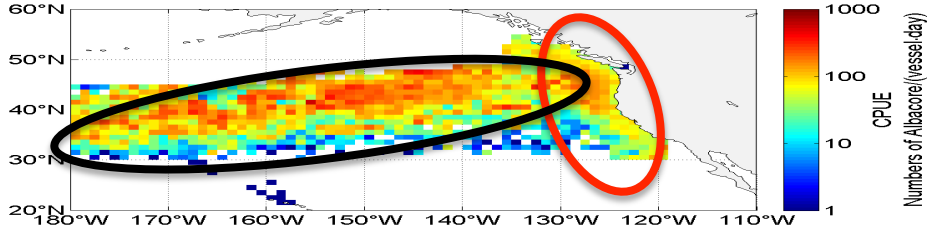
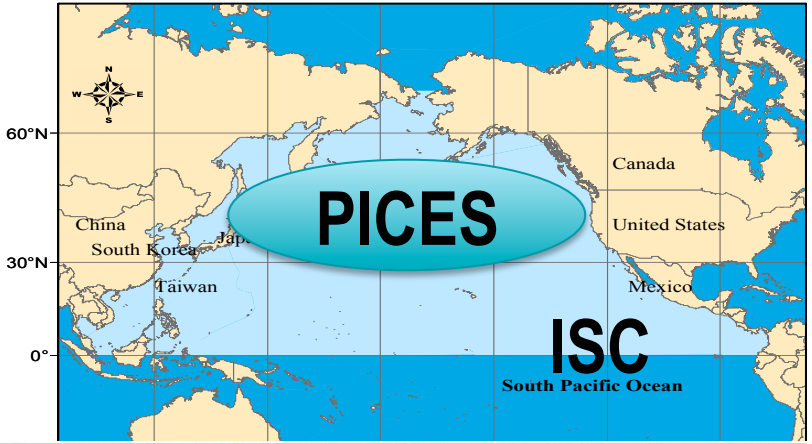
ToR Questions:
Q2, Q5, Q6

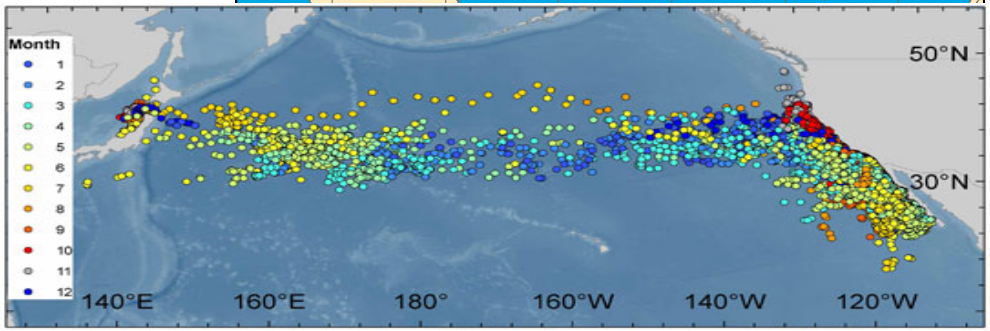


Relation to Environmental and Biological Signals





- HMS are spatially-structured and their distribution is linked to environmental and biological signals
- Fisherman cue in on these signals
- HMS assessments generally assume no spatial structure, increasing the uncertainty in stock status designations
- Understanding how these signals impact HMS distributions and catch will advance stock assessment science, resulting in more effective CMMs.



ISC-PICES Working Group

Research Themes:

1. Influence of oceanographic conditions on the distribution and production of commercial pelagic fish species in the North Pacific Ocean (short-term);
2. Linking oceanographic conditions to fleet and fisher behaviour (ecosystem stressors) to improve understanding of fishery indices used in assessing stock status (short-term); and
3. Climate change effects on North Pacific marine ecosystems and impacts on pelagic fish dynamics (long-term)

Species of Interest:

1. Pacific Bluefin Tuna
2. North Pacific Albacore

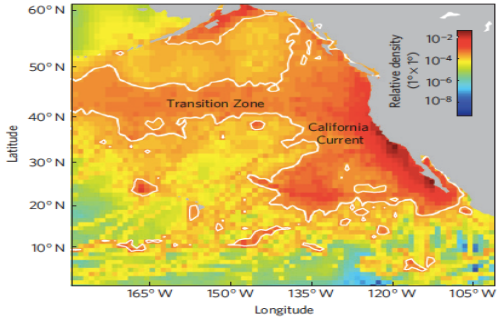


Figure 1 | Density of top predators within the eastern North Pacific.

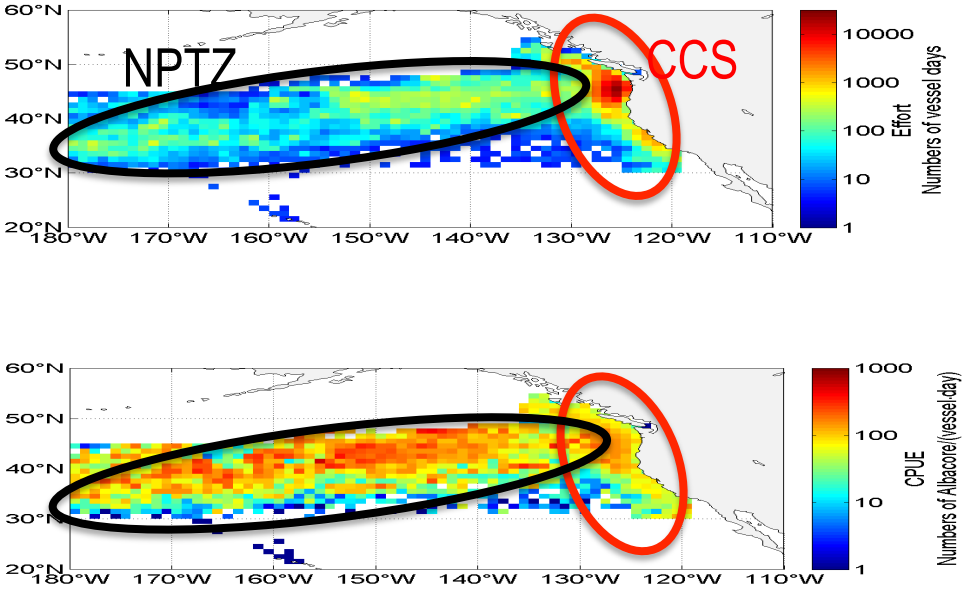
North Pacific Albacore Research

Oceanographic Influences on Albacore Distribution in the Northeast Pacific: Importance of Open Ocean and Coastal Frontal Zones

Yi Xu, Karen Nieto, Steven Teo, Sam McClatchie, and John Holmes

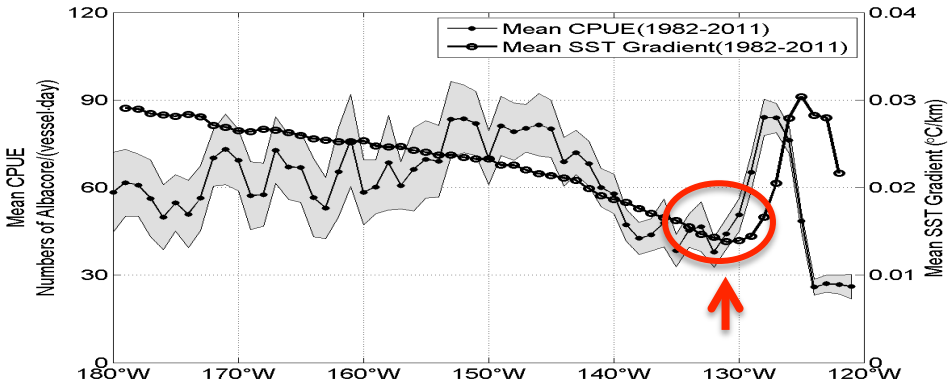
- Assess the environmental influences, especially frontal zones, on albacore distribution over long time scales (1982-2011) and large spatial scales (northeast Pacific) and incorporate this information into the stock assessment.

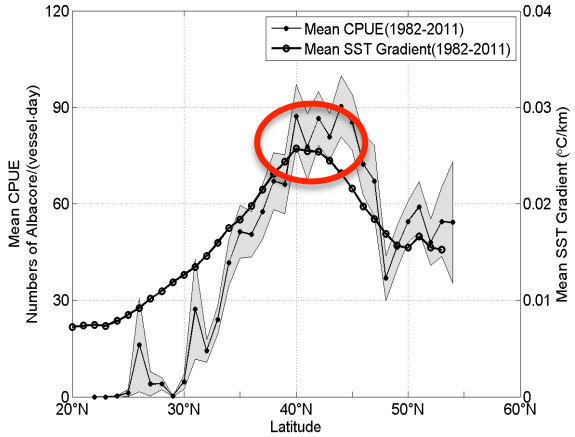
- Two main study areas: North Pacific Transition Zone (NPTZ), California Current System (CCS).



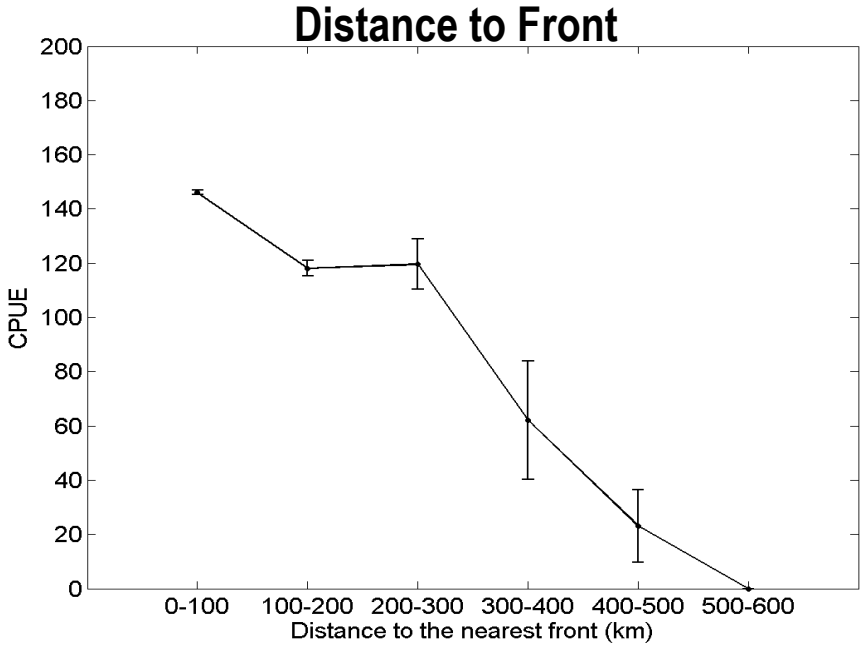
NPTZ Study - Spatiotemporal changes in mean SST gradient and CPUE

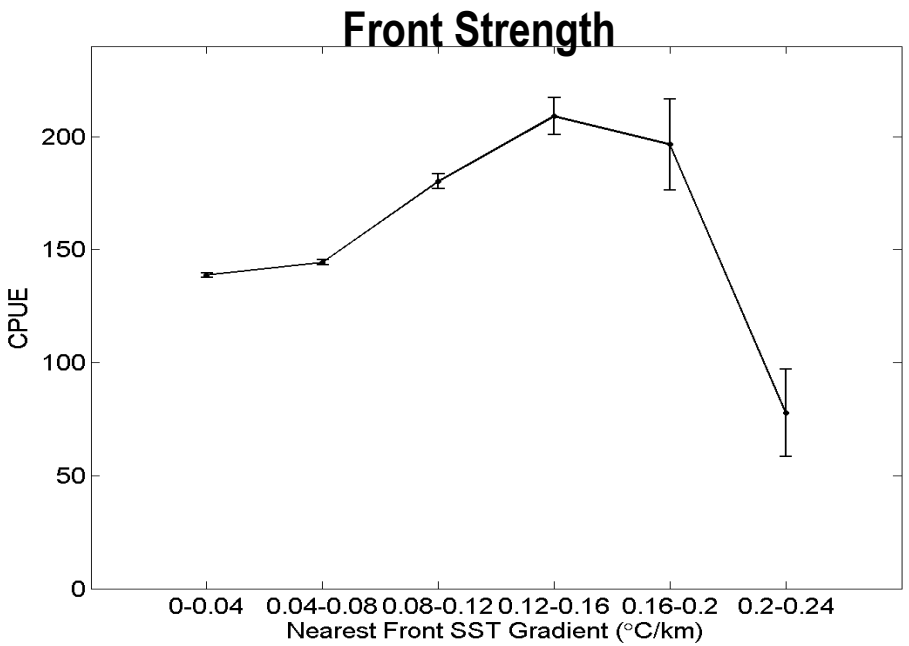
- SST gradient decreases from west to east, reaching min@130W, before rapidly increase near the coast.
- Albacore CPUE generally has higher value in the transition zone, and reaching min@132-135W, and rapidly increase near the coast.
- The latitudinal patterns of albacore CPUE corresponds well with SST gradient, both reach the max@ ~40-45N.
- SST gradients and albacore CPUE move to the north in summer and come back in fall.





NPTZ Study - CPUE vs. Frontal Distance & Strength





Albacore tend to aggregate near the front with the highest CPUE occurring 0-100km to the front.

Albacore CPUE exhibited a dome-shaped response to the SST gradient of the nearest front, reaching a maxima when SST gradient was 0.12-0.16C/km.

Summary – NPTZ Study

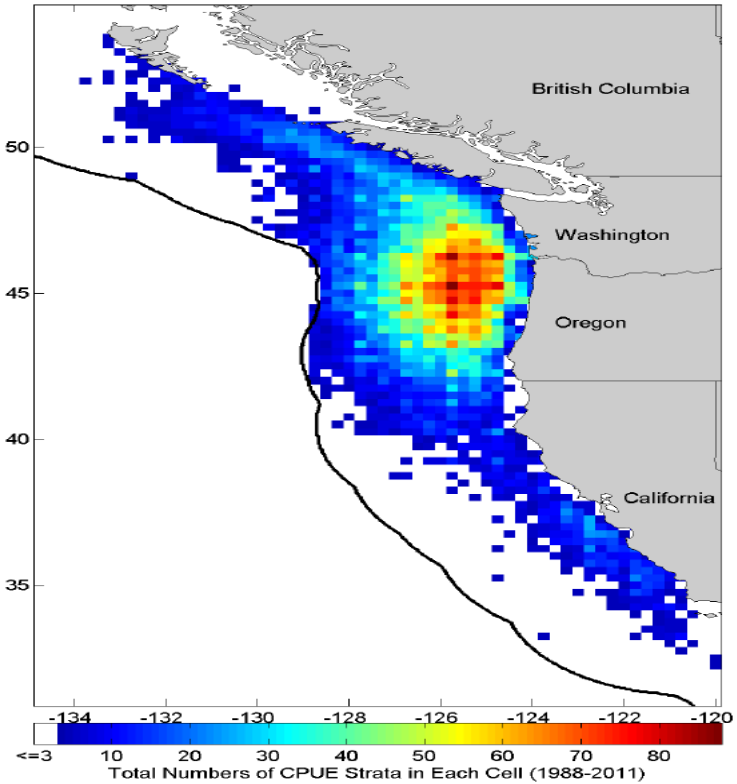
- Albacore distribution appears to be related to the distribution and strength of SST fronts over large spatial and temporal scales
- Albacore tend to aggregate near fronts, with highest CPUE observed within 100km of the nearest front, but had a dome-shaped response to the strength of front
- Area definitions used to standardize abundance indices in the albacore stock assessment were modified based on changes in SST fronts identified here

CCS Study

Region: from shore to 200nm

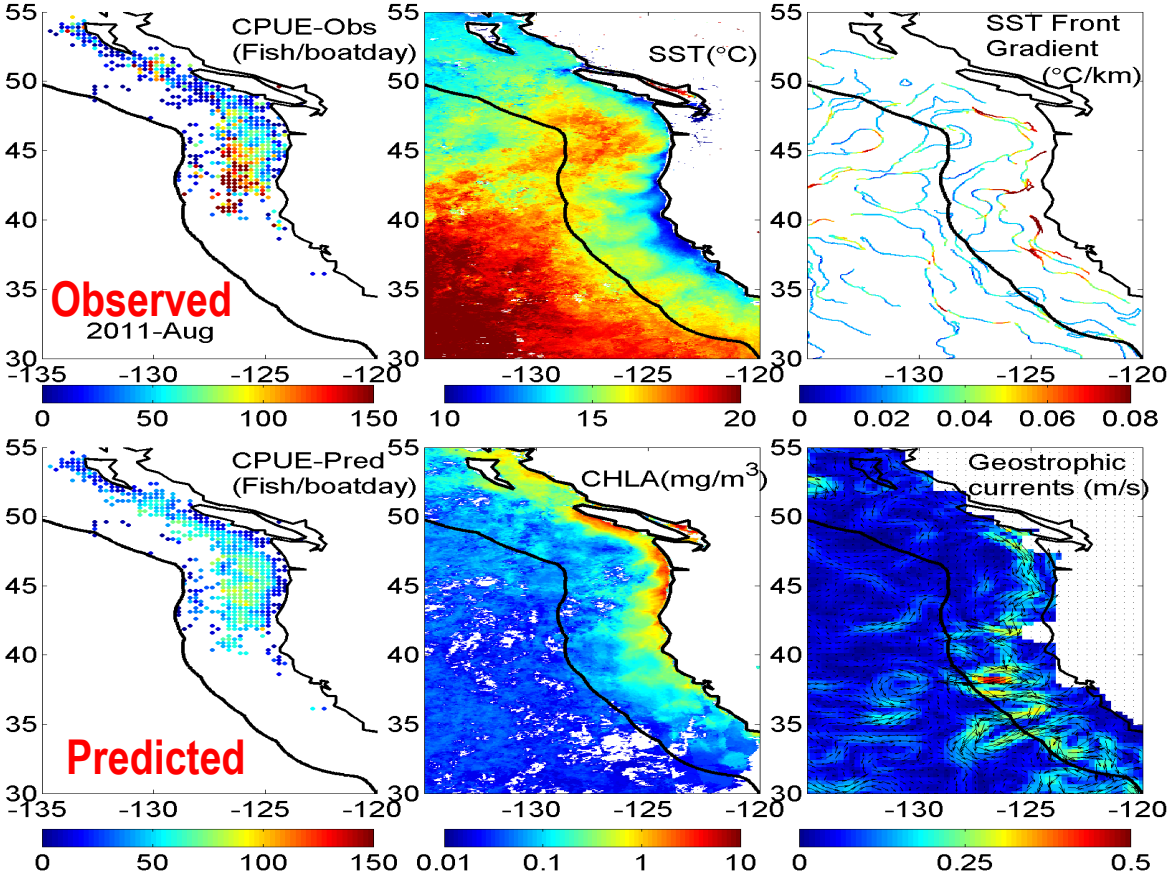
Spatiotemporal Resolution: ¼ x ¼ degrees; 1988-2011

Method: use Boosted Regression Tree model (BRT) to study CPUE distribution associated with environmental co-varies (SST, chl-a, front, geostrophic currents)



CCS Study- Model predictions vs observations

- Most important contributors to CPUE are SST and chlorophyll
- Model can represent general patterns, but not extreme high values
- Observed and model-predicted CPUEs were higher inshore of about 100 km from the coast, in warmer, low chlorophyll waters
- Cross-validation of BRT model results (24 yrs) show robust model performance, explaining 31.7 ± 1.1% of CPUE variability



Summary – CCS Study

- BRT model can represent general patterns of albacore CPUE, but not extreme high values
- Albacore CPUEs were higher in warm, low chlorophyll waters, near SST fronts
- Fishermen have been fishing on fronts for a long time, and most fishing occurs within 5 km of detected fronts
- Future work – how will climate change impact albacore distribution in the future?

Albacore and Climate Change Impacts

- Impacts of climate change on albacore distribution is still largely unknown
- ISC developing an MSE for North Pacific albacore tuna; incorporating impact of climate change into the operational model is necessary
- Understanding impacts is important for negotiations between US and Canada on the US-Canada albacore treaty, which currently allows a limited number of Canadian albacore vessels to fish in US waters and vice-versa
- Currently, albacore are more available in US waters (benefitting Canadian fishermen)
- But if climate change shifts albacore northward into Canadian waters, the treaty may be more beneficial to US fishermen

Adaptive Sampling - Habitat Modeling

Problem:

- The distribution of HMS is influenced by oceanographic conditions.
- Surveys to estimate abundance, collect biological samples or conduct tagging are costly.
- Imperative that surveys be adaptable so that the probability of encountering the target fish is high.

Adaptive Sampling - Habitat Modeling

SWFSC HMS Surveys

- Thresher Shark (ongoing)
  - Relative abundance
  - Biological sampling
- North Pacific Albacore Tuna (ongoing)
  - Biological sampling
  - Tagging
- Pacific Bluefin Tuna (planning)
  - Biological sampling
  - Tagging ????

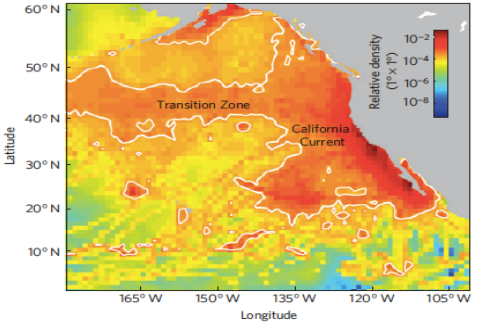
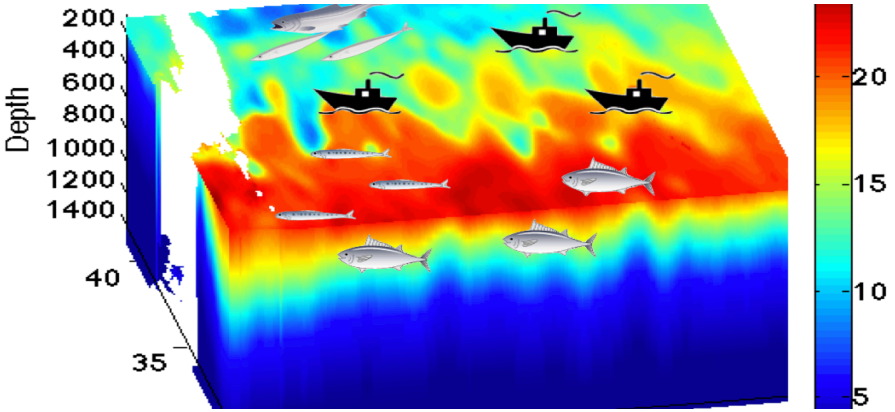


Figure 1 | Density of top predators within the eastern North Pacific.

Adaptive Sampling - Habitat Modeling

Strategy

- Develop species-specific habitat models
  - Mine existing data (including published scientific research)
  - Identify factors affecting distribution
  - Validate models
  - Implement



Pacific HMS Research

Strengths

- HMS surveys ensure significant encounter rates and are cost efficient
- Environmental influences are being incorporated into HMS assessments
- Partnerships have been developed with the goal of advancing stock assessments (next generation)

Challenges

- Timely development of habitat models and implementation of HMS adaptive sampling programs
- Sustaining the ISC-PICES partnership given the current resources
- Securing sufficient funding to support HMS research in the Pacific Ocean – currently non-existent

Strategies

- Advertise rotational assignments at the SWFSC to advance HMS assessments and habitat modeling
- Develop a visiting scientist program for non-government scientists (including foreign nationals) at the SWFSC
- Partner up with the PIFSC on HMS related research
- Continue to seek funding for Pacific HMS


Questions